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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
09/652,841	08/31/2000	Vishnu K. Agarwal	98-0616.02	4006

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EXAMINER

DIAZ, JOSE R

ART UNIT	PAPER NUMBER
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2815

DATE MAILED: 11/27/2002

Please find below and/or attached an Office communication concerning this application or proceeding.

**Office Action Summary**

Application No.

09/652,841

Applicant(s)

AGARWAL, VISHNU K.

Examiner

José R Díaz

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-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

**Period for Reply**

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If the period for reply specified above is less than thirty (30) days, a reply within the statutory minimum of thirty (30) days will be considered timely.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133).
- Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

**Status**

- 1) ☒ Responsive to communication(s) filed on 15 October 2002.
- 2a) ☒ This action is **FINAL**. 2b) ☐ This action is non-final.
- 3) ☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

**Disposition of Claims**

- 4) ☒ Claim(s) 91-98 and 102-105 is/are pending in the application.
- 4a) Of the above claim(s) \_\_\_\_\_ is/are withdrawn from consideration.
- 5) ☐ Claim(s) \_\_\_\_\_ is/are allowed.
- 6) ☒ Claim(s) 91-98 and 102-105 is/are rejected.
- 7) ☐ Claim(s) \_\_\_\_\_ is/are objected to.
- 8) ☐ Claim(s) \_\_\_\_\_ are subject to restriction and/or election requirement.

**Application Papers**

- 9) ☐ The specification is objected to by the Examiner.
- 10) ☐ The drawing(s) filed on \_\_\_\_\_ is/are: a) ☐ accepted or b) ☐ objected to by the Examiner.
- Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).
- 11) ☐ The proposed drawing correction filed on \_\_\_\_\_ is: a) ☐ approved b) ☐ disapproved by the Examiner.
- If approved, corrected drawings are required in reply to this Office action.
- 12) ☐ The oath or declaration is objected to by the Examiner.

**Priority under 35 U.S.C. §§ 119 and 120**

- 13) ☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
- a) ☐ All b) ☐ Some \* c) ☐ None of:
1. ☐ Certified copies of the priority documents have been received.
  2. ☐ Certified copies of the priority documents have been received in Application No. \_\_\_\_\_.
  3. ☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).
- \* See the attached detailed Office action for a list of the certified copies not received.
- 14) ☐ Acknowledgment is made of a claim for domestic priority under 35 U.S.C. § 119(e) (to a provisional application).
- a) ☐ The translation of the foreign language provisional application has been received.
- 15) ☒ Acknowledgment is made of a claim for domestic priority under 35 U.S.C. §§ 120 and/or 121.

**Attachment(s)**

- 1) ☒ Notice of References Cited (PTO-892)
- 2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
- 3) ☒ Information Disclosure Statement(s) (PTO-1449) Paper No(s) 18, 20.
- 4) ☐ Interview Summary (PTO-413) Paper No(s). \_\_\_\_\_.
- 5) ☐ Notice of Informal Patent Application (PTO-152)
- 6) ☐ Other: \_\_\_\_\_.

## DETAILED ACTION

### *Claim Objections*

- Claims 91, 94 and 102 are objected to because of the following informalities:
  - Applicant identifies the same chemical compound by using two different labels. For example, the carbon-silicon compounds hexamethyldisilane and hexamethyldisilazane are both known in the art as **HMDS** and having the same chemical composition of  $[(CH_3)_3Si]_2$ .

Appropriate correction is required.

### *Claim Rejections - 35 USC § 112*

- The following is a quotation of the first paragraph of 35 U.S.C. 112:

The specification shall contain a written description of the invention, and of the manner and process of making and using it, in such full, clear, concise, and exact terms as to enable any person skilled in the art to which it pertains, or with which it is most nearly connected, to make and use the same and shall set forth the best mode contemplated by the inventor of carrying out his invention.

- Claim 92 is rejected under 35 U.S.C. 112, first paragraph, as containing subject matter which was not described in the specification in such a way as to reasonably convey to one skilled in the relevant art that the inventor(s), at the time the application was filed, had possession of the claimed invention. The limitation of forming a third conductive layer over the second conductive layer is not supported by the Specification. For instance see Figures 4 and 5, wherein the layer deposited is a passivation layer (34) (BPSG) and not a conductive layer as now claimed.

***Claim Rejections - 35 USC § 103***

➤ The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

(a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negated by the manner in which the invention was made.

➤ Claims 91-98 are rejected under 35 U.S.C. 103(a) as being unpatentable over Applicant's Specification in view of George et al. (US Pat. No. 5,332,444).

Regarding claim 91, Applicant acknowledges that it is well known in the art to form a capacitor by providing a first and second plates (25, 32) and a dielectric (26) formed between the first and second plates, the second plate including first and second conductive layers (28, 30) (see Fig. 2). However, Applicant does not acknowledge a surface treatment wherein the surface of the first conductive layer is exposed to a material selected from the group of diborane, phosphine and carbon-silicon compound before the second conductive layer is formed. George et al. teach a HMDS treatment for conductive substrate to reduce the ability of such conductive substrate to associate with oxygen (see col. 7, lines 6-9 and 18-31). Please note that such a treatment is performed prior to forming a second conductive layer (see col. 7, lines 6-9 and 18-31). Therefore, it would have been obvious to one having ordinary skill in the art at the same time the invention was made to modify Applicant's Specification to include the step of treating the surface of first conductive layer with HMDS prior to forming the second conductive layer. The ordinary artisan would have been motivated to modify Applicant's

Specification in the manner described above for at least the purpose of removing oxide contaminants residing on the surface of the conductive substrate.

Regarding claim 92, Applicant acknowledges that the step of providing a capacitor comprises an in-process capacitor; and a further step of providing a third layer (34) over the second conductive layer (30) (see Fig. 3).

Regarding claim 93, Applicant acknowledges that the first and second conductive layers (28, 30) are the top plate (32) of the capacitor (see Fig. 2).

Regarding claim 94, Applicant acknowledges that it is well known in the art to form a capacitor by providing a first and second plates (25, 32) and a dielectric (26) formed between the first and second plates, the second plate including first and second conductive layers (28, 30) and an oxide layer (36) between the first and second conductive layer (see Fig. 3). Furthermore, Applicant acknowledges that is well known in the art to expose the capacitor to a thermal process after the step of forming the second conductive layer (see page 6, lines 5-8). However, Applicant does not acknowledge a surface treatment wherein the surface of the first conductive layer is exposed to a material selected from the group of diborane, phosphine and carbon-silicon compound before the second conductive layer is formed. George et al. teach a HMDS treatment for conductive substrate to reduce the ability of such conductive substrate to associate with oxygen (see col. 7, lines 6-9 and 18-31). Please note that such a treatment is performed prior to forming a second conductive layer (see col. 7, lines 6-9 and 18-31). Therefore, it would have been obvious to one having ordinary skill in the art at the same time the invention was made to modify Applicant's Specification to

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include the step of treating the surface of first conductive layer with HMDS prior to forming the second conductive layer. The ordinary artisan would have been motivated to modify Applicant's Specification in the manner described above for at least the purpose of removing oxide contaminants residing on the surface of the conductive substrate.

Regarding claim 95, Applicant acknowledges that in the conventional method of forming the capacitor, a thick oxide layer (36) of about 10 - 40Å is formed on the first conductive layer (28) (see page 7, lines 1-6). However, Applicant does not acknowledge a reducing the thickness of the oxide layer to less than 10 Å. As stated before, George et al. teach a HMDS treatment for conductive substrate to reduce the ability of such conductive substrate to associate with oxygen (see col. 7, lines 6-9 and 18-31). Since the HMDS treatment disclosed by George et al. has the same result that Applicant intent to claim, it is inherent that the thickness of the oxide layer (36) is reduced to less than 10Å. Furthermore, it would have been obvious to one of ordinary skill in the art to reduce the thickness of such oxide layer to less than 10Å, since it has been held that where the general conditions of a claim are disclosed in the prior art, discovering the optimum or working ranges involves only routine skill in the art. In re Aller, 105 USPQ 233. Therefore, it would have been obvious to one having ordinary skill in the art at the same time the invention was made to modify Applicant's Specification to include the step of treating the surface of first conductive layer with HMDS prior to forming the second conductive layer such that the thickness of the oxide layer is reduced to less than 10Å. The ordinary artisan would have been motivated to modify Applicant's

Specification in the manner described above for at least the purpose of reducing the ability of such conductive layer to associate with oxygen.

Regarding claim 96, Applicant acknowledges that the oxide layer (36) is comprised of silicon dioxide (page 6, lines 9-10).

Regarding claim 97, Applicant acknowledges that the dielectric (26) is comprised of tantalum pentoxide (see page 5, line 23-24).

Regarding claim 98, Applicant acknowledges that the first conductive layer (28) is comprised of tungsten nitride (see page 5, lines 27-28).

➤ Claims 102-104 are rejected under 35 U.S.C. 103(a) as being unpatentable over Park et al. (US Pat. No. 5,723,384) in view of Mak et al. (US Pat. No. 6,162,715).

Regarding claim 102, Park et al. teach a method for fabricating a capacitor (see Fig. 15) comprising the steps of: providing the first conductive plug (35) (see Fig. 11), providing a  $WN_x$  conductive barrier (39) (see Fig. 15) and forming the second conductive layer (see col. 4, lines 32-33). However, Park et al. fails to teach treating the surface of the barrier surface with a material selected from the group of diborane, phosphine and carbon-silicon compound before to the second conductive layer is formed. Mak et al. teach a method of forming a second conductive layer over a  $WN_x$  conductive barrier layer (8) by first treating the surface of the  $WN_x$  conductive barrier layer (8) with a gas containing diborane ( $B_2H_6$ ), and then, the second conductive layer (9) is provided (see Abstract, last two sentences and col. 5, lines 9-25). Therefore, it would have been obvious to one having ordinary skill in the art at the same time the

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invention was made to modify Park et al. to include the step of treating the surface of the  $WN_x$  conductive barrier layer with diborane prior to forming the second conductive layer. The ordinary artisan would have been motivated to modify Park et al. in the manner described above for at least the purpose of removing fluorine from the reaction.

Regarding claim 103, Park et al. teach that the conductive plug (35) can be formed of polysilicon (see col. 3, lines 57-59).

Regarding claim 104, Park et al. teach a barrier layer (39) formed of  $WN_x$  (see Fig. 14).

➤ Claim 102-104 are rejected under 35 U.S.C. 103(a) as being unpatentable over Park et al. (US Pat. No. 5,723,384) in view of George et al. (US Pat. No. 5,332,444).

Regarding claims 102, Park et al. teach a method for fabricating a capacitor (see Fig. 15) comprising the steps of: providing the first conductive plug (35) (see Fig. 11), providing a conductive barrier (39) (see Fig. 15) and forming a second conductive layer (see col. 4, lines 32-33). However, Park et al. fails to teach treating the surface of the conductive barrier surface with a material selected from the group of diborane, phosphine and carbon-silicon compound before to the second conductive layer is formed. George et al. teach a HMDS treatment for conductive substrate to reduce the ability of such conductive substrate to associate with oxygen (see col. 7, lines 6-9 and 18-31). Please note that such a treatment is performed prior to forming a second conductive layer (see col. 7, lines 6-9 and 18-31). Therefore, it would have been



obvious to one having ordinary skill in the art at the same time the invention was made to modify Park et al. to include the step of treating the surface of conductive substrate comprised of a barrier layer and a first conductive plug with HMDS prior to forming the second conductive layer. The ordinary artisan would have been motivated to modify Park et al. in the manner described above for at least the purpose of removing oxide contaminants residing on the surface of the conductive substrate.

Regarding claim 103, Park et al. teach that the conductive plug (35) can be formed of polysilicon (see col. 3, lines 57-59).

Regarding claim 104, Park et al. teach a barrier layer (39) formed of  $WN_x$  (see Fig. 14).

➤ Claim 105 is rejected under 35 U.S.C. 103(a) as being unpatentable over Park et al. (US Pat. No. 5,723,384) in view of Mak et al. (US Pat. No. 6,162,715), and further in view of Mak et al. (US Pat. No. 6,309,713 B1).

Regarding claim 105, a further different between the present invention and the prior arts is the material used as the second conductive layer or upper electrode. Mak et al. ('713) teach that is well known in the art to use copper as the second conductive layer in a capacitor structure comprised of a  $WN_x$  barrier layer (see col. 4, lines 62-67 and col. 5, lines 13-15). Therefore, it would have been obvious to one having ordinary skill in the art at the same time the invention was made to further modify Park et al. to include a second conductive layer formed of copper. The ordinary artisan would have

been motivated to further modify Park et al. in the manner described above for at least the purpose of providing electrical contact to other semiconductor devices.

### ***Double Patenting***

➤ A rejection based on double patenting of the "same invention" type finds its support in the language of 35 U.S.C. 101 which states that "whoever invents or discovers any new and useful process ... may obtain a patent therefor ..." (Emphasis added). Thus, the term "same invention," in this context, means an invention drawn to identical subject matter. See *Miller v. Eagle Mfg. Co.*, 151 U.S. 186 (1894); *In re Ockert*, 245 F.2d 467, 114 USPQ 330 (CCPA 1957); and *In re Vogel*, 422 F.2d 438, 164 USPQ 619 (CCPA 1970).

A statutory type (35 U.S.C. 101) double patenting rejection can be overcome by canceling or amending the conflicting claims so they are no longer coextensive in scope. The filing of a terminal disclaimer cannot overcome a double patenting rejection based upon 35 U.S.C. 101.

➤ Claims 102-105 are provisionally rejected under 35 U.S.C. 101 as claiming the same invention as that of claims 81-85 of copending Application No. 09/652,993. This is a provisional double patenting rejection since the conflicting claims have not in fact been patented. The claims are directed toward the same method of affecting a surface of a tungsten nitride layer on a capacitor comprised of a first conductive plug by exposing the tungsten nitride layer to a material selected from the group consisting of: diborane, phosphine and a carbon-silicon compound such as methylsilane, hexamethyldisilane, and hexamethyldisilazane; and providing a polysilicon layer on the tungsten nitride layer.

***Response to Arguments***

➤ Applicant's arguments with respect to claims 91-98 and 102-105 have been considered but are moot in view of the new ground(s) of rejection.

***Conclusion***

➤ Applicant's amendment necessitated the new ground(s) of rejection presented in this Office action. Accordingly, **THIS ACTION IS MADE FINAL**. See MPEP § 706.07(a). Applicant is reminded of the extension of time policy as set forth in 37 CFR 1.136(a).

A shortened statutory period for reply to this final action is set to expire **THREE MONTHS** from the mailing date of this action. In the event a first reply is filed within **TWO MONTHS** of the mailing date of this final action and the advisory action is not mailed until after the end of the **THREE-MONTH** shortened statutory period, then the shortened statutory period will expire on the date the advisory action is mailed, and any extension fee pursuant to 37 CFR 1.136(a) will be calculated from the mailing date of the advisory action. In no event, however, will the statutory period for reply expire later than **SIX MONTHS** from the date of this final action.

***Correspondence***

Any inquiry concerning this communication or earlier communications from the examiner should be directed to José R Díaz whose telephone number is (703) 308-


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6078. The examiner can normally be reached on 9:00-5:00 Monday, Tuesday, Thursday and Friday.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Eddie Lee can be reached on (703) 308-1690. The fax phone numbers for the organization where this application or proceeding is assigned are (703) 308-7722 for regular communications and (703) 746-3891 for After Final communications.

Any inquiry of a general nature or relating to the status of this application or proceeding should be directed to the receptionist whose telephone number is (703) 308-0956.

JRD  
November 26, 2002



EDDIE LEE  
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